

C₆₀-Co_x complex built by atomic/molecular manipulation using low temperature scanning tunneling microscopy and its physical properties studied by tunneling spectroscopy

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Abstract

Understanding of the electronic process at the interface and the interaction between the organic molecule and metal at atomic/molecular scale is critical to build the new generation molecule electronic devices. Moreover, atom manipulation using scanning tunneling microscopy (STM) allows the formation of atomic controlled artificial molecule-metal conjugate [1–3]. As the interface between C₆₀ molecule and magnetic material holds promises for molecular spin electronics [4,5], we studied the interaction between C₆₀ molecule and Co atoms. Using a low temperature (LT) STM and scanning tunneling spectroscopy (STS), we manipulate atoms and molecules to build C₆₀-Co_x complex and study its physical properties.

The Co atoms and C₆₀ molecules are deposited in-situ on a clean Au(111)/mica surface in ultra-high vacuum (<10⁻¹⁰ mbar) at low temperature (5K). We show that it is possible to move a C₆₀ molecule above a Co adatom and then manipulate the molecule-atom ensemble as a single object, suggesting that we formed a Co-C₆₀ complex (Figure 1). Moreover C₆₀-Co_x entities with x>1 can be formed by a combined lateral manipulation of C₆₀ molecule and Co adatoms in two different ways: the molecule is successively moved towards individual adatoms, or a Co_x cluster is built by atomic manipulation then the molecule is moved towards the cluster. We have been able to add up to 9 Co atoms to a C₆₀ molecule, which is, to our knowledge, the largest number achieved in such molecule-metal atom complex.

We performed dI/dU spectroscopy using the lock-in technique in order to measure the influence of Co on the molecular spectrum. Although possible doping effect still need to be clarified, the C₆₀-Co_x spectrum exhibit the main features of the C₆₀ single molecule suggesting that the pi states are at most only slightly affected by the interaction between the molecule and the Co atoms.

References

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Figures

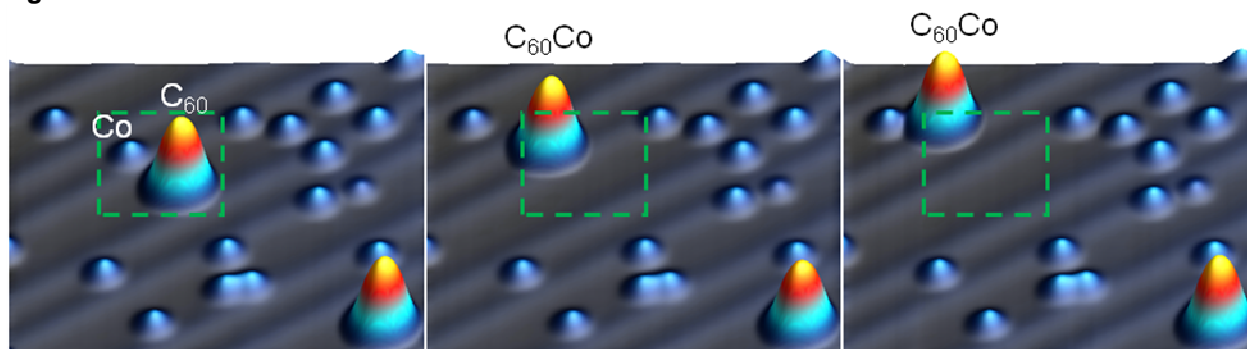


Figure 1: Left, the C₆₀ molecules (bigger spots) and the Co atoms (smaller spots) on the Au(111) surface; Middle, Formation of C₆₀-Co complex; Right, The movement of C₆₀-Co complex. The dashed squares guide the eyes by indicating the initial position of C₆₀ molecule.